

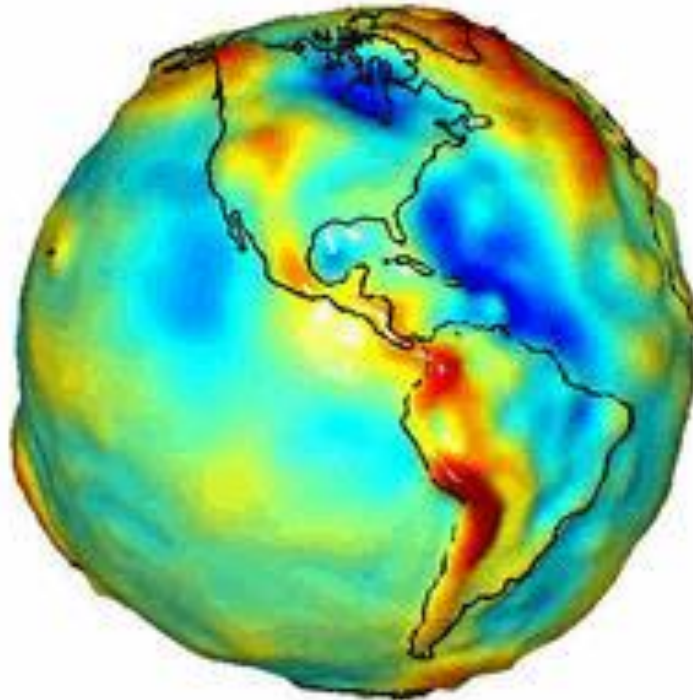
# Using NASA Satellite and Modeling Resources for Monitoring Groundwater Availability and Variability

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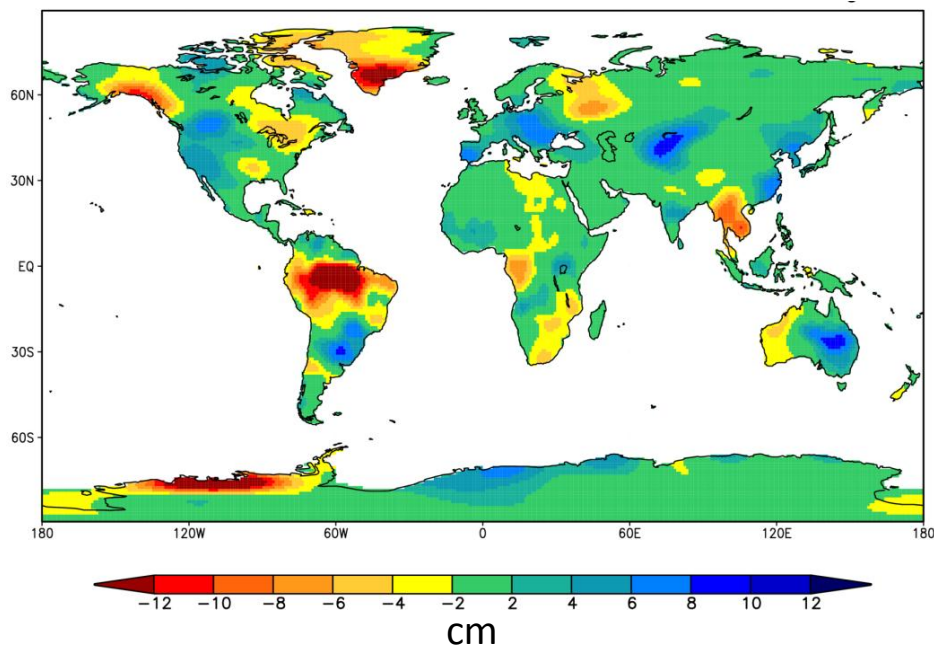
*Greenbelt, MD*



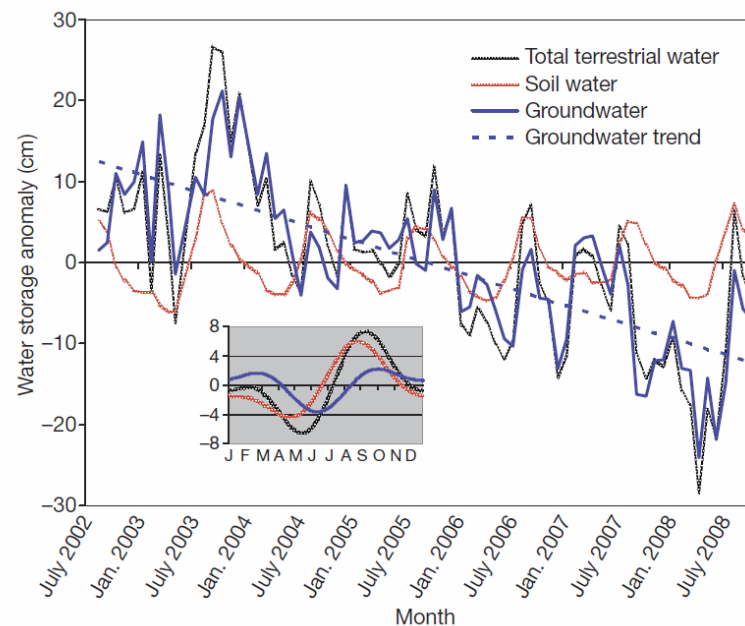


# Identifying Areas of Water Stress and Replenishment

## Changes in Annual-Mean Terrestrial Water Storage Between 2009 and 2010



## Water Storage Anomalies in Northwestern India

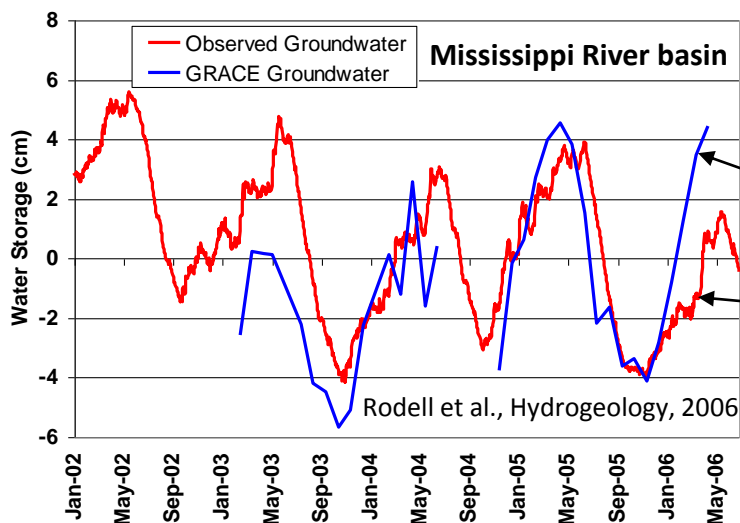
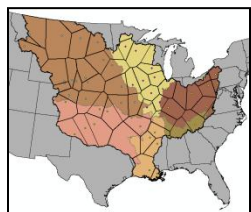


***Observations from NASA's Gravity Recovery and Climate Experiment (GRACE) mission provide estimates of terrestrial water storage variability (the sum of groundwater, soil water, surface water, snow, and ice).***

Source: Matt Rodell, NASA GSFC



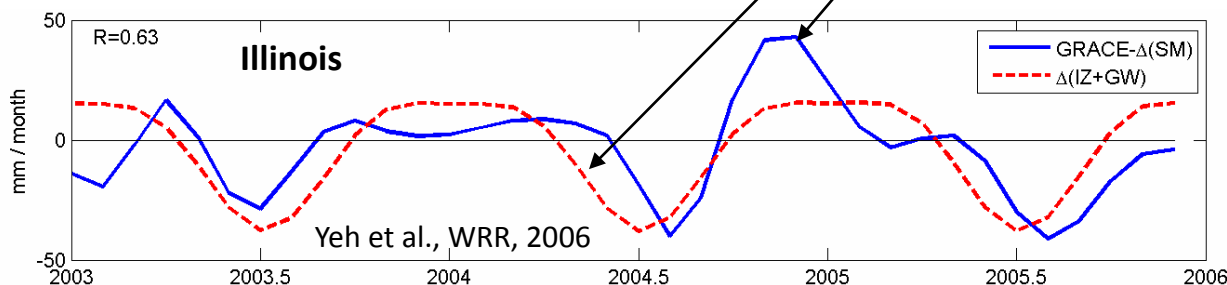
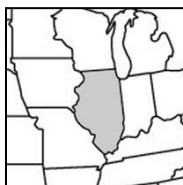
# Quantifying Changes in Soil Water Storage is Essential for Sustainable Water Management



GRACE groundwater estimate

Groundwater well observations

GRACE groundwater estimates (smoothed)



***When combined with a numerical model (top) or in situ observations (bottom), groundwater can be isolated from GRACE terrestrial water storage observations.***

Source: Matt Rodell, NASA GSFC

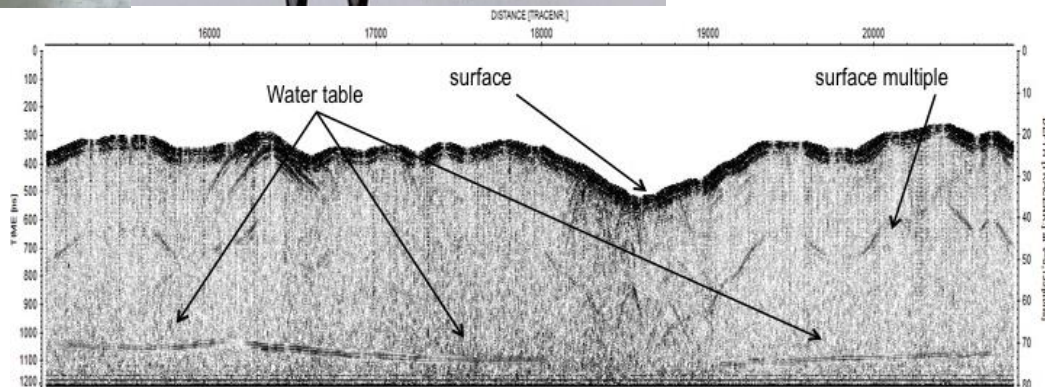
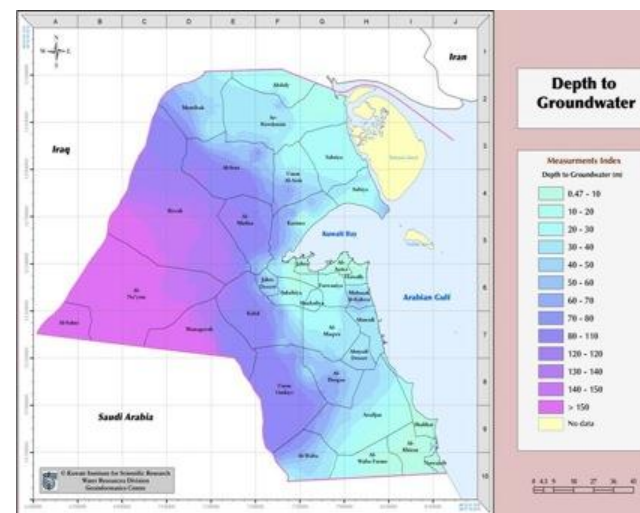


# JPL Airborne Radar Sounder for High-Resolution Mapping of Shallow Aquifers



## Instrument

1. Short pulse sounding radar ( $< 20$  ns) at 40 and 75 MHz center frequencies
2. 20 and 40 MHz bandwidths at 40 and 75 MHz
3. Multiple antennas
4. Platform: Kuwait police Dauphin helicopter and Kuwait Air Force P3



***Aircraft - based radar provides high-resolution mapping of the regional distribution of shallow aquifers in the hyper-arid areas.***



## NASA Points of Contact

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